Project Report: EVOLUTION OF A HABITABLE PLANET: Planetary Habitability and Life Detection

Project Investigator:	***Steinn Sigurdsson***

Project Progress

In early July, 2003, a Science paper I was lead author on came out providing strong evidence for an old (~ 12 Gyr) jovian planet in a metal–poor, distant stellar system. The presence of the object had long been suspected; analysis of Hubble Space Telescope (HST) data confirmed many aspects of the nature of the system. The result was presented at a NASA Space Science Update (SSU) on July 10th 2003. Followup paper published in Publications of the Astronomical Society of the Pacific (PASP) Conf Prog in spring 2004, discussed the issues and theoretical concerns in more detail and considered some of the alternative models proposed since the paper. A letter on prospects for detecting transient electromagnetic signatures from catastrophic planet collision around other stars was published (postdoc lead author), and also presented at conferences. Followup research is planned. In collaboration with a student (A. Mandell), we published a letter on the survival of terrestrial planets in systems where a Jovian planet has undergone type II migration and discussed the implications for terrestrial planet search strategies. We plan further theoretical follow–up of this issue and related planet formation scenarios. In collaboration with a student (J. Debes), we started receiving data on a cycle 12 HST project (currently in progress). Preliminary analysis of the data suggests we have found several candidate planets and low mass brown dwarfs around nearby DAZ stars. Follow–up observations to confirm the detections are being requested; if confirmed, we may have made direct–imaging detections of some nearby extra–solar planets. Preliminary results were presented at NAI and Space Telescope Science Institute (STScI) meetings.

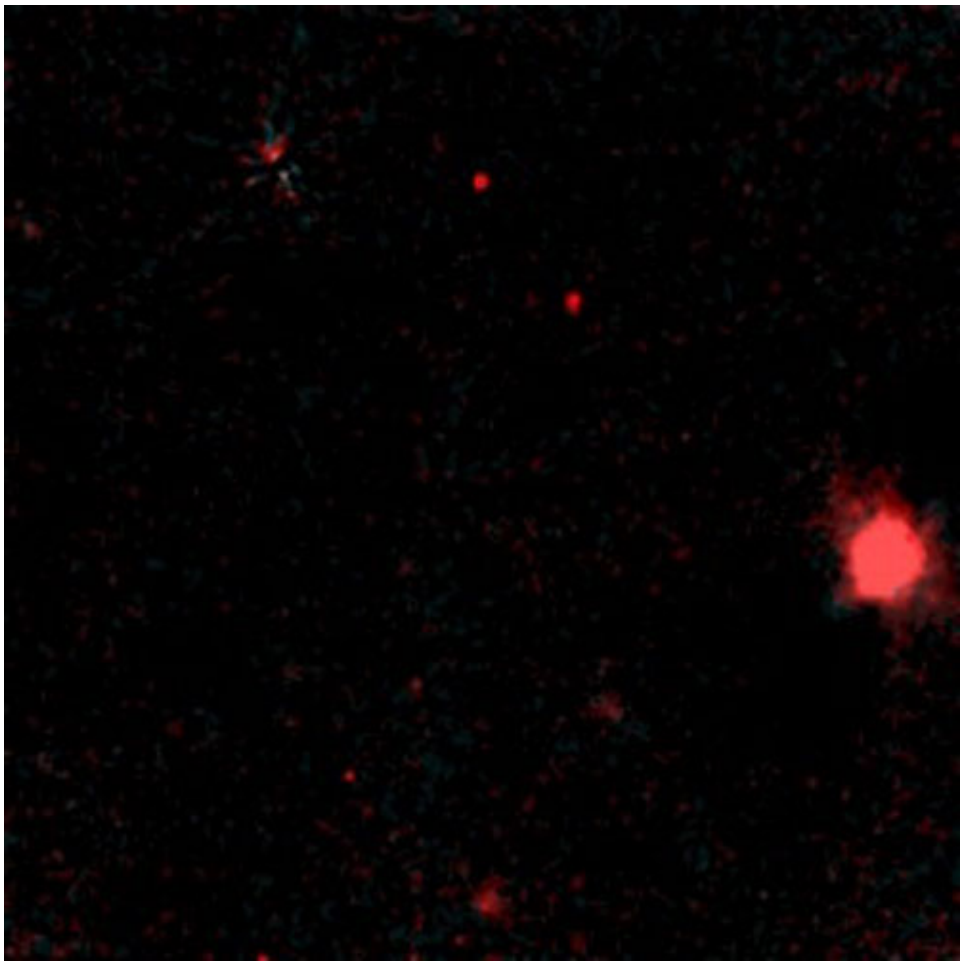

Fig 1: HST infra−red image of a candidate planet near a masked out white dwarf.

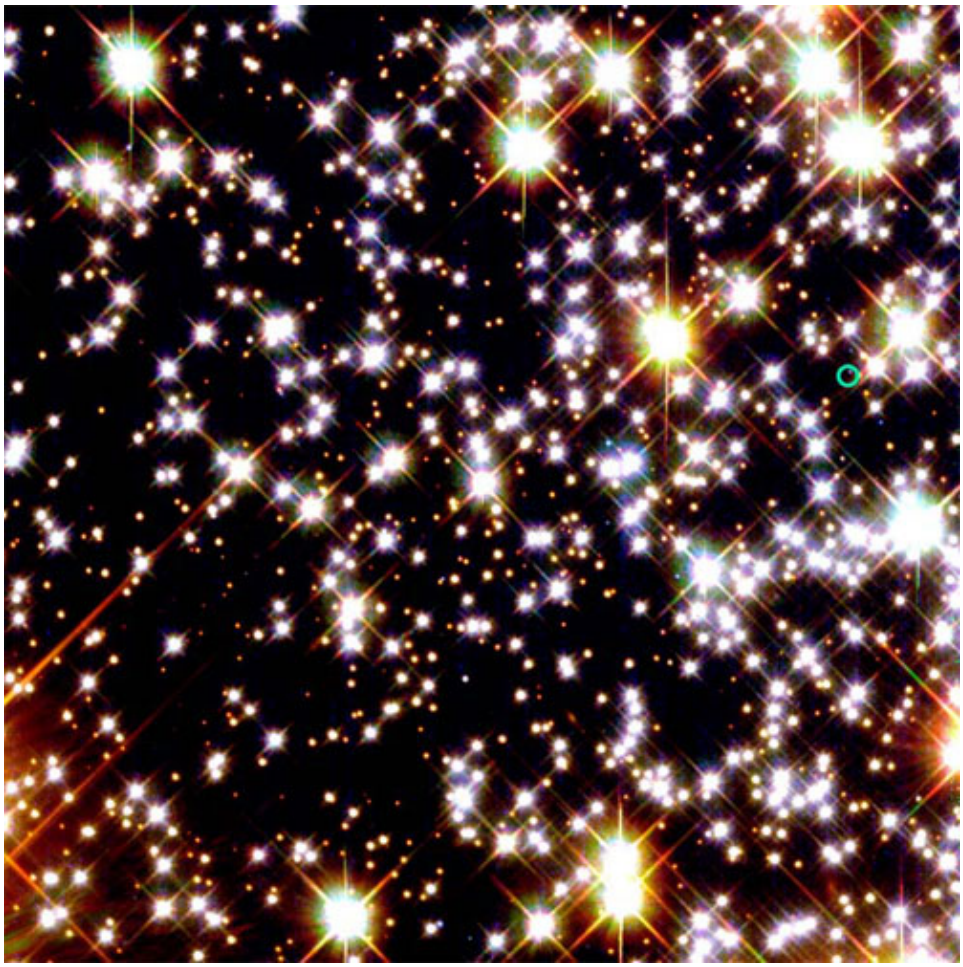

Fig 2: HST image showing (blue star in the green circle) the location of a white dwarf, one of the two stars about which a planet mass object orbits, within the globular cluster Messier 4.

Highlights

- Oldest planet discovered
- Possible “first photo” of extrasolar planet

Roadmap Objectives

- ***Objective No. 1.1:*** Models of formation and evolution of habitable planets
- ***Objective No. 1.2:*** Indirect and direct astronomical observations of extrasolar habitable planets

Mission Involvement

*Mission Class**	*Mission Name (for class 1 or 2) OR Concept (for class 3)*	*Type of Involvement***
1	Hubble Space Telescope	Project Investigator
1	Spitzer Space Telescope	Project Investigator
2	TPF	Project Investigator

* Mission Class: Select 1 of 3 Mission Class types below to classify your project:
1. Now flying OR Funded & in development (e.g., Mars Odyssey, MER 2003, Kepler)
2. Named mission under study / in development, but not yet funded (e.g., TPF, Mars Lander 2009)
3. Long−lead future mission / societal issues (e.g., far−future Mars or Europa, biomarkers, life definition)

** Type of Involvement = Role / Relationship with Mission
Specify one (or more) of the following: PI, Co−I, Science Team member, planning support, data analysis, background research, instrument/payload development, research or analysis techniques, other (specify).

PI (with graduate student Debes) on GO−9834, a NICMOS search for nearby Jovians. PI (with graduate student Debes) on recently approved Spitzer followup to above HST project. PI on submitted proposal to followup results from above proposals as lead in to TPF science.

Cross Team Collaborations

Recently initiated an informal collaboration with Prof Brad Hansen (UCLA) on dynamical evolution of planetesimals during the evolution of intermediate mass stars, no results as yet, collaboration just begun.